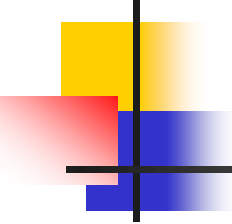


RCS 205

Operating Systems

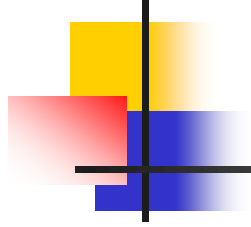
Lecture 2:

Historic Overview

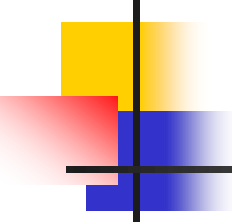


Lecture 2:

- Scope:
 - Types of Computer Systems.
 - Development of Operating Systems.
- Goals:
 - Examine the development of computer hardware and operating system software.
 - Review the historic development of operating system.

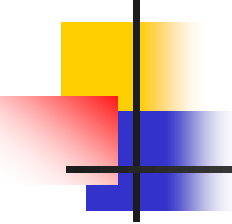


Computer Systems



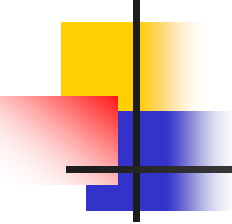
Batch Systems:

- Early computer systems were *batch systems*.
- Common *input devices* were card readers and tape drives.
- Common *output devices* were line printers, tape drives and card punchers
- Users would submit their jobs to the operator.



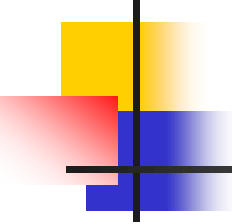
Batch Systems...

- Major task of O/S was to transfer control from one job to the next
- Jobs with similar needs were batched together and run as a group to speed processing
- The *turnaround time* in these systems was high
- The CPU, is often idle because of the disparity in speed between it and the I/O devices.



Batch Systems...

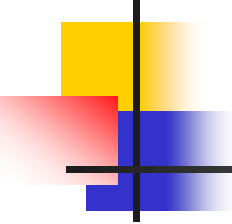
- Spooling was introduced to reduce the *turnaround time* and CPU *idle time* in these systems, the spool.
- Spooling, in essence uses the disk as a buffer, for reading as far ahead as possible on input device and for storing output files until the output device is able to accept them.



Multiprogrammed Batched Systems-

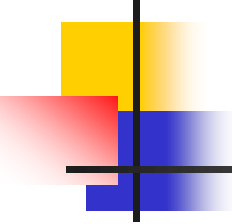
Multiprogramming

- ◆ Spooling results in several ready jobs to be put in memory.
- ◆ Selecting the job is referred to as *job scheduling*
- The O/S manages the process of job scheduling
 - i.e. does some memory management
- The most important aspect of job scheduling is the ability to multiprogramm.



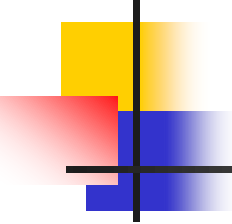
Multiprogramming:...

- The O/S picks and executes any of the jobs in memory
- Eventually, a job will wait for some operation such as I/O
- In multiprogramming, when this happens the O/S, simply switches to and executes another job.
- Making this decision is known as *CPU scheduling*.



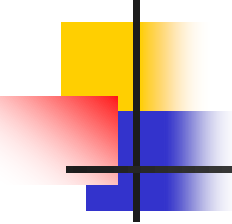
Time Sharing Systems

- ♦ *Time-sharing, or multitasking* is a logical extension of multiprogramming.
- In time-sharing, multiple jobs, are executed by the CPU switching between so frequently that the users may not realize
- Time-sharing systems were developed to provide interactive use of the computer system
- It allows many users to share the computer simultaneously.
- As the system switches rapidly from one user to the other, the user is given the impression that they have their own computer



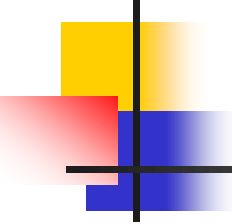
Timer Interrupts:

- Programs were given a specified amount of time for their execution .
- The monitor (O/S) had the ability to interrupt the program in case its execution time expired.



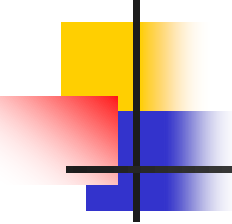
Virtual Memory:

- Gives a program the illusion that it has as much memory as it needs
- A program is divided into pages so that a page is brought in memory at any given time
- There was shifting of pages depending on the processing demands



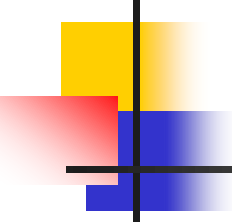
Parallel System:

- Most computers are single processor systems
- However, the trend is towards having multiprocessing systems
- Such systems have more than one processor in close communication, sharing the computer bus, clock, memory and peripheral devices
- Motivation for having such systems is to improve the *throughput* and *reliability* of the system.



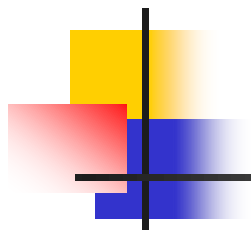
Real-Time Systems:

- Used when there are rigid time requirements on the operation of a processor or the flow of data
- Often used as a control device in a dedicated application.
- **Sensors bring data to the computer.**
- The computer must analyze the data and possibly adjust control to modify the sensor inputs.
- Examples include: systems that control scientific experiments, medical imaging systems and industrial control systems

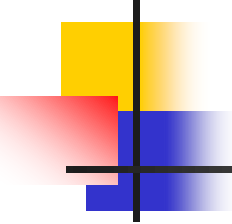


Distributed systems:

- Consists of multiple processors, interconnected by a communication network.
- Offer virtual parallelism.
- Enable sharing of information among several users.
- Main strengths: *throughput, reliability, efficiency.*



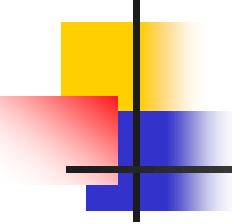
Computer Hardware development Vs Operating Systems Development



Operating Systems development

(A Historical perspective)

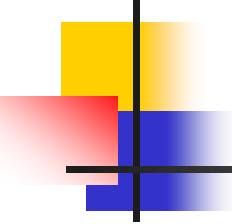
- O/S have developed through a number of phases and are basically connected to the computer generations (architecture)



A Historical perspective...

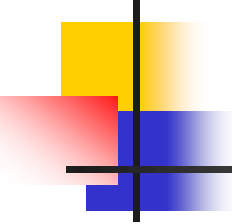
1. First generation (1945 –1955) – Vacuum tubes and plug boards

- First generation computers were basically mechanical devices
- Computers were programmed manually by setting switches, plugging and unplugging cables.
- Operations of these machines were slow, cumbersome and tedious.



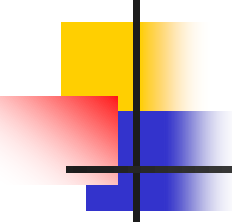
A Historical perspective...

- The operations of these machines were very slow, cumbersome and tedious.
- 'Stored program' concept was introduced by Von Neumann
- Led to the realization of digital computers and the inception of the programming concept.
- The computers had all features of modern computers i.e. CPU (ALU, Registers), memory and I/O facilities.



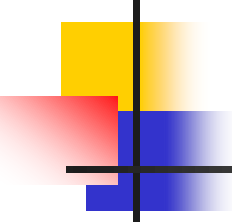
A Historical perspective...

- Programming was done using machine language
- Each user would be allocated a block of time and exclusive access at any given time.
- Preparing a machine language program for execution involved:
 - Writing a program and operating it directly from the console
 - Programs and data would be manually loaded into memory



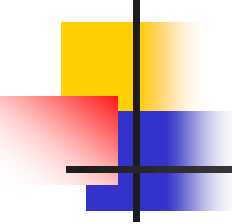
A Historical perspective...

- Appropriate buttons would be pushed to set the starting address and start the execution of the program
- In case of errors, programmer halts the program and examine contents of memory and registers to debug the program
- In the 1950's
 - Assembly languages were developed
 - Assemblers for compiling Assembly language to machine language
 - Punched cards were used for I/O operations



A Historical perspective...

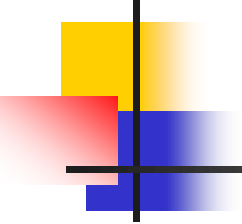
- The problems during this time included:
 - Significant setup time (time taken to load, assemble and execute programs)
 - The CPU sat idle for lengths of time, under utilizing the resources and abilities of the computer

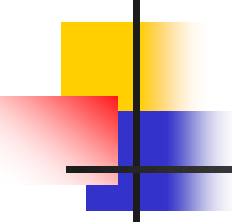


A Historical perspective...

2. Second Generation Computers (1955 – 1965) – Transistors and Batch Systems

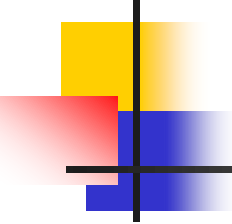
- Characteristics of Computers and software at this time:
 - Used transistors instead of vacuum tubes.
 - Machine independent languages like COBOL, FORTRAN and ALGOL became common.
 - System software like compilers, utilities for tape/card conversion and batch monitors were made available.

- 
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- Computers used for scientific and business data processing
 - The problems with the computers:
 - CPU sat idle for some time due to time reserved and not being used and slow I/O data transfers.
 - There was an I/O and computer speed disparity as computers had become faster than the I/O devices.



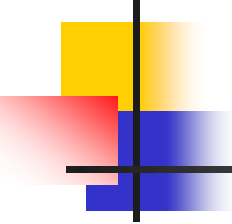
A Historical perspective...

- Solutions to these problems:
 - Use of professional operators
 - Batching of computer jobs
 - Jobs with similar needs were batched together to make use of available set ups common to them e.g. All COBOL, FORTRAN
 - Use of a rudimentary operating system called *batch monitor* to reduce human setup time.



A Historical perspective...

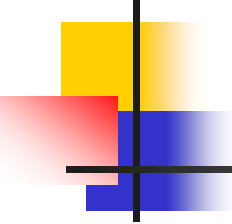
- Solutions to these problems:
 - *Off-line Spooling* to supplement batch processing. Tapes rather than punched cards were used for input
 - *Multiple buffering* was introduced overlapping CPU and I/O operations . It builds blocks of data into memory before output and also blocks of data before input to memory.



A Historical perspective...

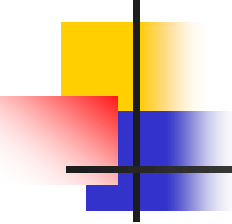
3. Third Generation Computers (1965 – 1980) – ICs and multiprogramming

- IC technology replaced transistor technology.
- Led to reduction in the cost of computers, size, efficiency, speed and reliability.
- Semi-conductor (IC) memory became common.
- Microprogramming came to a wide spread use.



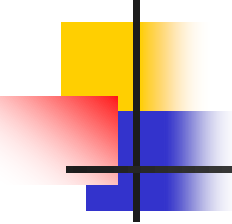
A Historical perspective...

- Concurrent programming techniques like time-sharing and multiprogramming used to share CPU.
- Use of magnetic Disks became common.
- The problems during this time:
 - Change in technology led to I/O and CPU speed disparities resulting to high CPU idle time.
 - Poor utilization of the CPU, which had become even faster resulting in high *turnaround times* and low *throughput*.



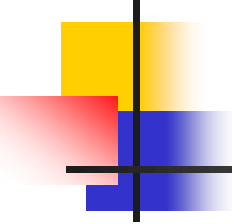
A Historical perspective...

- Solution to these problems:
 - Introduction of *multiprogramming* – Memory partitioned, job loaded to partition and executed, removed from CPU on performing I/O
 - *Online Spooling* became a common phenomenon - Used together with magnetic disks which is a DAD.
 - The desire for applications requiring quick response paved way for *time-sharing*



A Historical perspective...

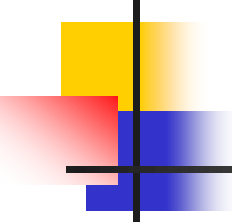
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 - *Online Spooling* became a common phenomenon - Used together with magnetic disks which is a DAD.
 - The desire for applications requiring quick response paved way for *time-sharing*.
 - *Real time systems* also became popular.



A Historical perspective...

4. Fourth Generation Computers (1980 ...) – VLSI and Personal Computers

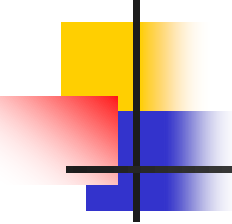
- VLSI led to the possibility of manufacturing a whole component in a single IC chip.
- This made the computers at this time to be fast, reliable, cheap and efficient.
- This led to:
 - Personal Computers
 - Parallel Processing systems
 - Computer Networks



A Historical perspective...

Personal Computers

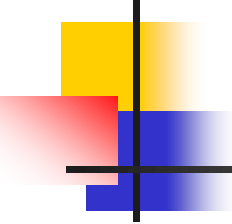
- Software industries were developed to manufacture the required software like single user O/S for use in personal computers.
- Initially, they were only single user O/S
- Now we have multitasking operating systems like Windows '95 where a user runs several tasks concurrently.
- These O/S have also opted for user convenience and responsiveness through better user interface (Graphical User Interface).



A Historical perspective...

Parallel Processing Systems

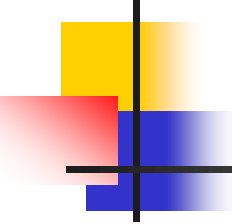
- Parallel systems make use of more than one processor to perform tasks.
- Operating systems for parallel systems were developed to efficiently exploit the underlying available hardware.



A Historical perspective...

Computer Networks

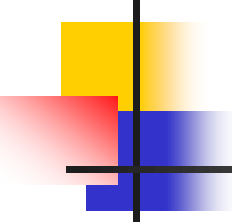
- Independent computers interconnected by a n/w to allow users share resources like printers, servers, plotters and hard disks.
- Could also exchange data through the communication medium.
- Networks can be categorized by the geographical they cover.



A Historical perspective...

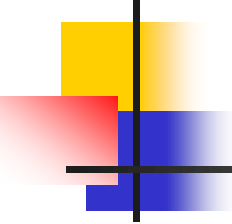
■ **Computer Networks**

- Consequently, they are divided into LAN (Local Area Networks) covering a smaller geographical region like a building or small town and
- WAN (Wide Area Networks) covering a larger geographical region like a city, continent or the entire globe.
- Network operating systems were developed to manage computers in a network.



Lecture review:

- Briefly describe three computer systems.
- Describe how multiprogramming enhances the performance of a computer system.
- Distinguish between multiprogramming and time-sharing.
- What is spooling? Distinguish between online and offline spooling.



Next lecture:

- Components and services.